



Taxonomic Paper

Records of larentiine moths (Lepidoptera: Geometridae) collected at the Station Linné in Sweden

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Abstract

Background

The island of Öland, at the southeast of Sweden, has unique geological and environmental features. The Station Linné is a well-known Öland research station which provides facilities for effective studies and attracts researchers from all over the world. Moreover, the station remains a center for ecotourism due to extraordinary biodiversity of the area. The present paper is aimed to support popular science activities carried out on the island and to shed light on diverse geometrid moth fauna of the Station Linné.

New information

As an outcome of several research projects, including the Swedish Malaise Trap Project (SMTP) and the Swedish Taxonomy Initiative (STI) conducted at the Station Linné, a list of larentiine moths (Lepidoptera: Geometridae) collected on the territory of the station is presented. Images of moths from above and underside are shown. Of the totally 192 species registered for Sweden, 41 species (more than 21%) were collected in close

proximity to the main building of the Station Linné. Malaise trap sampling of Lepidoptera is discussed.

Keywords

Alvar, checklist, diversity, faunistics, geometrid moths, Larentiinae, malaise trap sampling, Öland, Skogsby

Introduction

The island of Öland, at the southeast of Sweden, is famous for its dominant environmental feature, an Ordovician limestone pavement, which is called the Stora Alvaret (= the Great Alvar). Alvars are semi-natural grasslands which have been formed and developed due to long periods of human influence, including grazing (Rosén 1982). The Stora Alvaret has been designated as a World Heritage Site by UNESCO due to its unusual biodiversity and prehistory. Station Linné is situated on the island of Öland being a center for research, popular science activities, and ecotourism. The research station is named after Carl von Linné who visited Öland in 1741.

The Swedish Malaise Trap Project (SMTP), funded by the Swedish Species Information Centre (ArtDatabanken), is based at the Station Linné. The project aims to provide species determinations for the specimens obtained from Malaise traps sampling at a wide range of landscapes and habitats. For many groups, including geometrid moths, the final data release is still awaited. The present paper is aimed to present a first list of the larentiine moths collected at the Station Linné.

Materials and methods

Material for study was mainly collected using a UV light trap (UV), a mercury vapor light trap (MV) and net sweeping (NS) by O. Schmidt in 2014 (June 24-29, July 1-4) and 2015 (July 20-31) in the Mörbylånga kommun, Skogsby, Station Linné (56.6186 N, 16.4989 E). The UV light trap was placed between the tree and shrub rows along a walking path, with a meadow on one side and a swampy area on the other side (Fig. 1). The mercury vapor light trap was situated nearby, at the edge of the swamp (Fig. 2). The two light traps were separated by a row of trees and shrubs.

Furthermore, material collected as part of the SMTP in 2007 and 2008 using a Malaise trap (MF) located close to the main building of the Station Linné (see <http://www.stationlinne.se/sv/forskning/the-swedish-malaise-trap-project-smtp/traps/trap-id-2006-skogs>, Trap ID 2006) was checked and the larentiine moths identified. This Malaise trap was placed on a lawn, about 100 m north of the Alvar edge (56.6190 N, 16.4973 E) and was running from

April 2007 until November 2008. A note is given for the species recorded from Malaise trap samples only.



Figure 1.
UV light trap



Figure 2.
MV light trap

Additional material has been collected in the following locations: Borgholms kommun, Ismantorp; Borgholms kommun, Petgärdeträsk; Mörbylånga kommun, near Arontorp; Mörbylånga kommun, Gårdby; Mörbylånga kommun, Gillsättra_wet, Gillsättra_dry; Mörbylånga kommun, Jordtorpsåsen_wet, Jordtorpsåsen_dry; Mörbylånga kommun, Kalkstad; Mörbylånga kommun, Södra Sandby (Suppl. material 1). Specimens collected by net sweeping on Öland outside the station are marked with asterisk (NS*).

The genitalia of all small-sized moths were studied to correctly identify the species. The material was identified using the Lepidoptera collection of the Zoologische Staatssammlung München (ZSM, Germany) and publications by Mironov (2003), Elmquist et al. (2011) and Hausmann and Viidalepp (2012).

List of larentiine moth species collected at the Station Linné

Phibalapteryx virgata (Hufnagel, 1767)

- <http://eol.org/pages/4031647/overview>
- http://www.lepiforum.de/lepiwiki.pl?Phibalapteryx_virgata

Notes: Figs 3, 4



Figure 3.
Phibalapteryx virgata, above



Figure 4.
Phibalapteryx virgata, underneath

***Cidaria fulvata* (Forster, 1771)**

- <http://eol.org/pages/283762/overview>
- http://www.lepiforum.de/lepiwiki.pl?Cidaria_Fulvata

Notes: Figs 5, 6



Figure 5.
Cidaria fulvata, above



Figure 6.
Cidaria fulvata, underneath

***Colostygia olivata* (Denis & Schiffermüller, 1775)**

- <http://eol.org/pages/277279/overview>
- http://www.lepiforum.de/lepiwiki.pl?Colostygia_olivata

Notes: Figs 7, 8



Figure 7.
Colostygia olivata, above



Figure 8.
Colostygia olivata, underneath

***Colostygia pectinataria* (Knoch, 1781)**

- <http://eol.org/pages/278481/overview>
- http://www.lepiforum.de/lepiwiki.pl?Colostygia_Pectinataria

Notes: Figs 9, 10



Figure 9.
Colostygia pectinataria, above



Figure 10.

Colostygia pectinataria, underneath

***Cosmorhoe ocellata* (Linnaeus, 1758)**

- <http://eol.org/pages/270324/overview>
- http://www.lepiforum.de/lepiwiki.pl?Cosmorhoe_Ocellata

Notes: Figs 11, 12



Figure 11.

Cosmorhoe ocellata, above



Figure 12.

Cosmorhoe ocellata, underneath

***Eulithis prunata* (Linnaeus, 1758)**

- <http://eol.org/pages/281849/overview>
- http://www.lepiforum.de/lepiwiki.pl?Eulithis_Prunata

Notes: Figs 13, 14



Figure 13.

Eulithis prunata, above



Figure 14.
Eulithis prunata, underneath

***Eulithis mellinata* (Fabricius, 1787)**

- <http://eol.org/pages/284564/overview>
- http://www.lepiforum.de/lepiwiki.pl?Eulithis_Mellinata

Notes: Figs 15, 16



Figure 15.
Eulithis mellinata, above



Figure 16.

Eulithis mellinata, underneath

***Eulithis testata* (Linnaeus, 1761)**

- <http://eol.org/pages/286201/overview>
- http://www.lepiforum.de/lepiwiki.pl?Eulithis_Testata

Notes: Figs 17, 18



Figure 17.

Eulithis testata, above



Figure 18.

Eulithis testata, underneath

***Gandaritis pyraliata* (Denis & Schiffermüller, 1775)**

- <http://eol.org/pages/4017307/overview>
- http://www.lepiforum.de/lepiwiki.pl?Gandaritis_Pyraliata

Notes: Figs 19, 20



Figure 19.

Gandaritis pyraliata, above



Figure 20.

Gandaritis pyraliata, underneath

***Plemyria rubiginata* (Denis & Schiffermüller, 1775)**

- <http://eol.org/search?q=Plemyria+rubiginata&search=Go>
- http://www.lepiforum.de/lepiwiki.pl?Plemyria_Rubiginata

Notes: Figs 21, 22



Figure 21.

Plemyria rubiginata, above



Figure 22.

Plemyria rubiginata, underneath

***Thera cognata* (Thunberg, 1792)**

- <http://eol.org/pages/298019/overview>
- http://www.lepiforum.de/lepiwiki.pl?Thera_cognata

Notes: Figs 23, 24



Figure 23.

Thera cognata, above



Figure 24.

Thera cognata, underneath

***Eupithecia absinthiata* (Clerck, 1759)**

- <http://eol.org/pages/285123/overview>
- http://www.lepiforum.de/lepiwiki.pl?Eupithecia_absinthiata
- <http://mothphotographersgroup.msstate.edu/species.php?hodges=7586.1>

Notes: Figs 25, 26



Figure 25.

Eupithecia absinthiata, above



Figure 26.

Eupithecia absinthiata, underneath

***Eupithecia denotata* (Hübner, 1813)**

- <http://eol.org/search?q=Eupithecia+denotata&search=Go>
- http://www.lepiforum.de/lepiwiki.pl?Eupithecia_denotata
- http://www.euroleps.ch/seiten/s_art.php?art=geo_denotata

Notes: Figs 27, 28



Figure 27.

Eupithecia denotata, above



Figure 28.

Eupithecia denotata, underneath

***Eupithecia exiguata* (Hübner, 1813)**

- <http://eol.org/pages/284131/overview>
- http://www.lepiforum.de/lepiwiki.pl?Eupithecia_exiguata

Notes: Figs 29, 30



Figure 29.

Eupithecia exiguata, above



Figure 30.

Eupithecia exiguata, underneath

***Eupithecia icterata* (de Villers, 1789)**

- <http://eol.org/pages/281026/overview>
- http://www.lepiforum.de/lepiwiki.pl?Eupithecia_icterata

Notes: Figs 31, 32

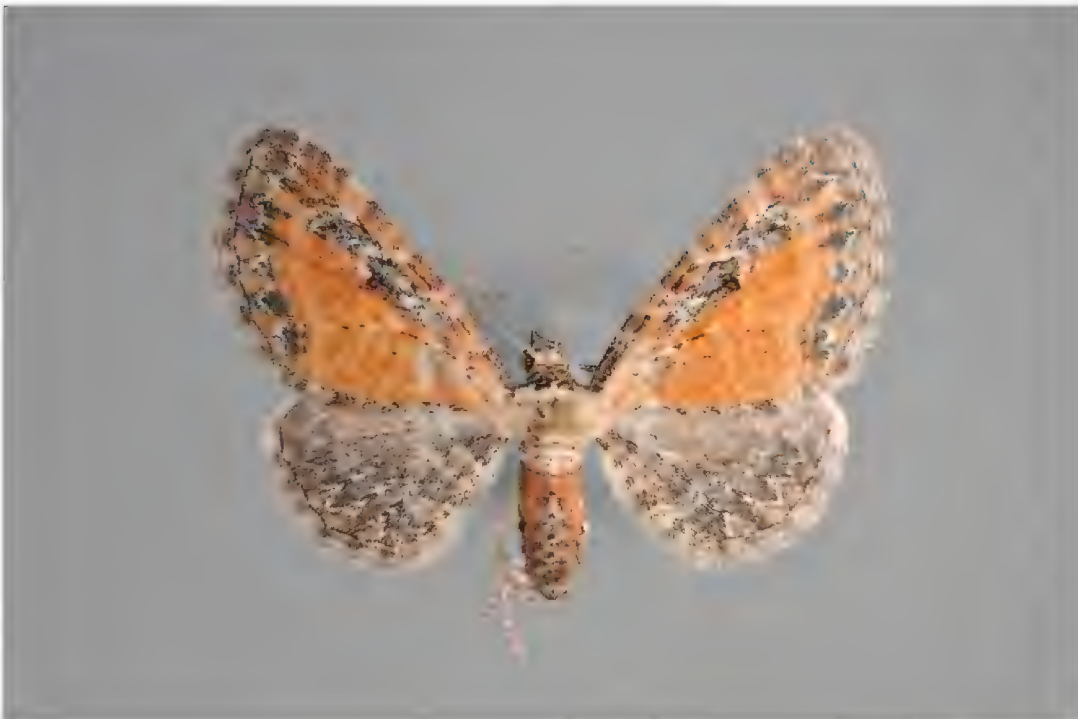


Figure 31.

Eupithecia icterata, above

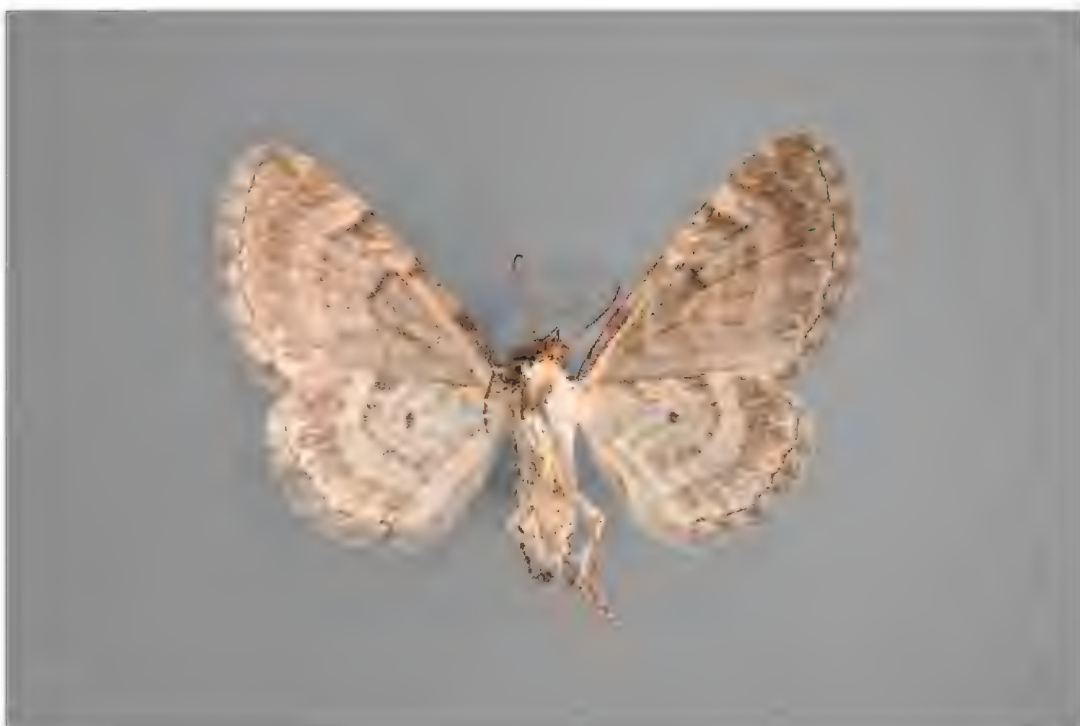


Figure 32.

Eupithecia icterata, underneath

***Eupithecia linariata* (Denis & Schiffermüller, 1775)**

- <http://eol.org/pages/283937/overview>
- http://www.lepiforum.de/lepiwiki.pl?Eupithecia_Linariata

Notes: Figs 33, 34



Figure 33.

Eupithecia linariata, above



Figure 34.

Eupithecia linariata, underneath

***Eupithecia nanata* (Hübner, 1813)**

- <http://eol.org/pages/287885/overview>
- http://www.lepiforum.de/lepiwiki.pl?Eupithecia_nanata

Notes: Figs 35, 36



Figure 35.

Eupithecia nanata, above, abdomen missing



Figure 36.

Eupithecia nanata, underneath, abdomen missing

***Eupithecia pusillata* (Denis & Schiffermüller, 1775)**

- <http://eol.org/search?http://eol.org/search?q=Eupithecia+pusillata&search=Go>
- http://www.lepiforum.de/lepiwiki.pl?Eupithecia_Pusillata

Notes: Figs 37, 38



Figure 37.

Eupithecia pusillata, above



Figure 38.

Eupithecia pusillata, underneath

***Eupithecia satyrata* (Hübner, 1813)**

- <http://eol.org/pages/292707/overview>
- http://www.lepiforum.de/lepiwiki.pl?Eupithecia_satyrata

Notes: Figs 39, 40



Figure 39.

Eupithecia satyrata, above



Figure 40.

Eupithecia satyrata, underneath

***Eupithecia subfuscata* (Haworth, 1809)**

- <http://eol.org/pages/286559/overview>
- http://www.lepiforum.de/lepiwiki.pl?Eupithecia_Subfuscata

Notes: Figs 41, 42



Figure 41.

Eupithecia subfuscata, above



Figure 42.

Eupithecia subfuscata, underneath

***Eupithecia subumbrata* (Denis & Schiffermüller, 1775)**

- <http://eol.org/pages/287281/overview>
- http://www.lepiforum.de/lepiwiki.pl?Eupithecia_subumbrata

Notes: Figs 43, 44



Figure 43.

Eupithecia subumbrata, above, abdomen missing



Figure 44.

Eupithecia subumbrata, underneath, abdomen missing

***Eupithecia succenturiata* (Linnaeus, 1758)**

- <http://eol.org/pages/292925/overview>
- http://www.lepiforum.de/lepiwiki.pl?Eupithecia_succenturiata

Notes: Figs 45, 46

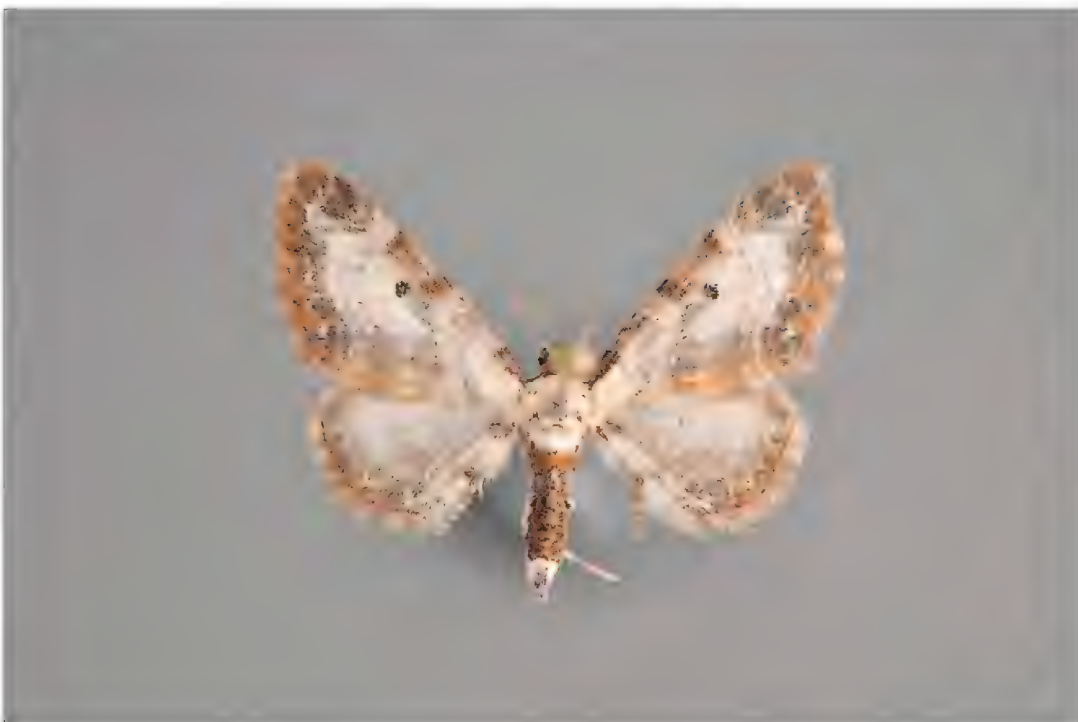


Figure 45.

Eupithecia succenturiata, above



Figure 46.

Eupithecia succenturiata, underneath

***Eupithecia tenuiata* (Hübner, 1813)**

- <http://eol.org/pages/285093/overview>
- http://www.lepiforum.de/lepiwiki.pl?Eupithecia_tenuiata

Notes: Figs 47, 48



Figure 47.

Eupithecia tenuiata, above



Figure 48.

Eupithecia tenuiata, underneath

***Eupithecia valerianata* (Hübner, 1813)**

- https://en.wikipedia.org/wiki/Eupithecia_valerianata
- http://www.lepiforum.de/lepiwiki.pl?Eupithecia_Valerianata

Notes: Figs 49, 50



Figure 49.

Eupithecia valerianata, above



Figure 50.

Eupithecia valerianata, underneath

***Pasiphila chloerata* (Mabille, 1870)**

- <http://eol.org/pages/4031644/overview>
- http://www.lepiforum.de/lepiwiki.pl?Pasiphila_Chloerata

Notes: Figs 51, 52



Figure 51.

Pasiphila chloerata, above



Figure 52.

Pasiphila chloerata, underneath

***Pasiphila rectangularata* (Linnaeus, 1758)**

- <http://eol.org/pages/277386/overview>
- http://www.lepiforum.de/lepiwiki.pl?Pasiphila_Rectangulata

Notes: Figs 53, 54

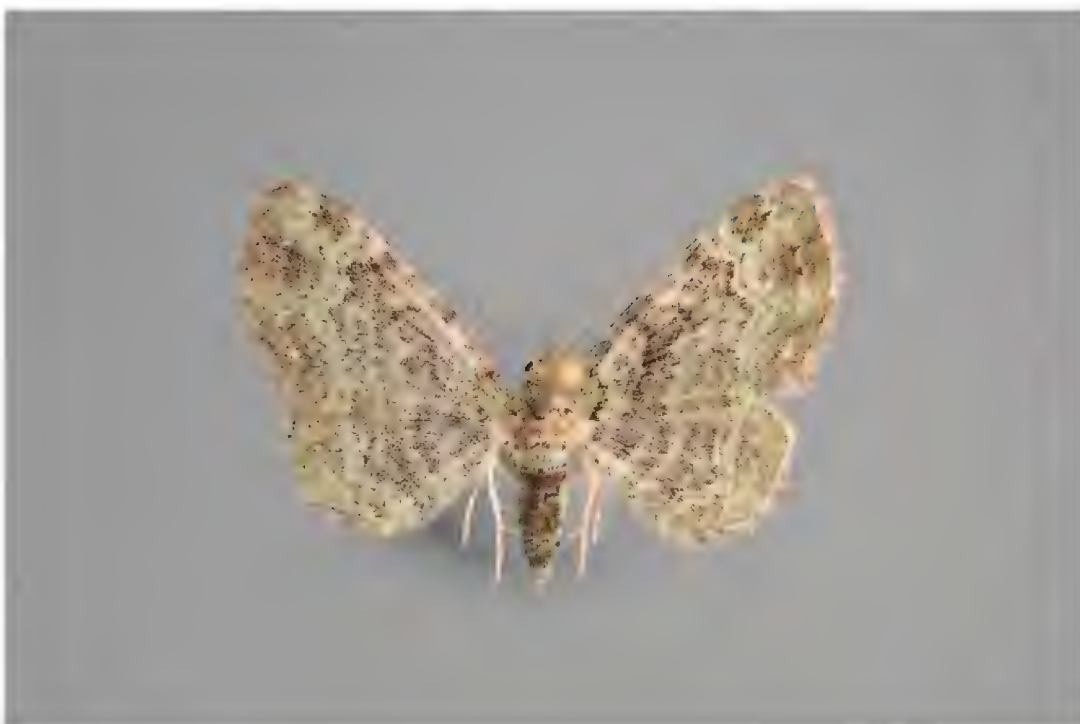


Figure 53.

Pasiphila rectangularata, above



Figure 54.

Pasiphila rectangularata, underneath

***Hydriomena furcata* (Thunberg, 1784)**

- <http://eol.org/pages/286763/overview>
- http://www.lepiforum.de/lepiwiki.pl?Hydriomena_furcata

Notes: Figs 55, 56



Figure 55.

Hydriomena furcata, above



Figure 56.

Hydriomena furcata, under

***Pelurga comitata* (Linnaeus, 1758)**

- <http://eol.org/pages/284799/overview>
- http://www.lepiforum.de/lepiwiki.pl?Pelurga_Comitata

Notes: Figs 57, 58



Figure 57.

Pelurga comitata, above



Figure 58.

Pelurga comitata, underneath

***Mesotype didymata* (Linnaeus, 1758)**

- <http://eol.org/pages/4012784/overview>
- http://www.lepiforum.de/lepiwiki.pl?Mesotype_Didymata

Notes: Figs 59, 60



Figure 59.

Mesotype didymata, above



Figure 60.

Mesotype didymata, underneath

***Perizoma alchemillata* (Linnaeus, 1758)**

- <http://eol.org/pages/295004/overview>
- http://www.lepiforum.de/lepiwiki.pl?Perizoma_Alchemillata

Notes: Figs 61, 62



Figure 61.

Perizoma alchemillata, above



Figure 62.

Perizoma alchemillata, underneath

***Philereme transversata* (Hufnagel, 1767)**

- <http://eol.org/pages/296282/overview>
- http://www.lepiforum.de/lepiwiki.pl?Philereme_transversata

Notes: Figs 63, 64



Figure 63.

Philereme transversata, above



Figure 64.

Philereme transversata, underneath

***Philereme vetulata* (Denis & Schiffermüller, 1775)**

- <http://eol.org/search?http://eol.org/search?q=Philereme+vetulata&search=Go>
- http://www.lepiforum.de/lepiwiki.pl?Philereme_vetulata

Notes: Figs 65, 66



Figure 65.

Philereme vetulata, above



Figure 66.

Philereme vetulata, underneath

***Scotopteryx chenopodiata* (Linnaeus, 1758)**

- <http://eol.org/pages/295986/overview>
- http://www.lepiforum.de/lepiwiki.pl?Scotopteryx_Chenopodiata

Notes: Figs 67, 68



Figure 67.

Scotopteryx chenopodiata, above



Figure 68.

Scotopteryx chenopodiata, underneath

***Pterapherapteryx sexalata* (Retzius, 1783)**

- <http://eol.org/pages/297593/overview>
- http://www.lepiforum.de/lepiwiki.pl?Pterapherapteryx_sexalata

Notes: Figs 69, 70



Figure 69.

Pterapherapteryx sexalata, above



Figure 70.

Pterapherapteryx sexalata, underneath

***Camptogramma bilineata* (Linnaeus, 1758)**

- <http://eol.org/search?http://eol.org/search?q=Camptogramma+bilineata&search=Go>
- http://www.lepiforum.de/lepiwiki.pl?Camptogramma_Bilineata

Notes: Figs 71, 72



Figure 71.

Camptogramma bilineata, above



Figure 72.

Camptogramma bilineata, underneath

***Catarhoe cuculata* (Hufnagel, 1767)**

- <http://eol.org/pages/276073/overview>
- http://www.lepiforum.de/lepiwiki.pl?Catarhoe_cuculata

Notes: Figs 73, 74



Figure 73.

Catarhoe cuculata, above



Figure 74.

Catarhoe cuculata, underneath

***Catarhoe rubidata* (Denis & Schiffermüller, 1775)**

- <http://eol.org/pages/279041/overview>
- http://www.lepiforum.de/lepiwiki.pl?Catarhoe_Rubidata

Notes: Figs 75, 76



Figure 75.

Catarhoe rubidata, above



Figure 76.

Catarhoe rubidata, underneath

***Epirrhoe alternata* (Müller, 1764)**

- <http://eol.org/search?q=Epirrhoe+alternata&search=Go>
- http://www.lepiforum.de/lepiwiki.pl?Epirrhoe_Alternata

Notes: Figs 77, 78

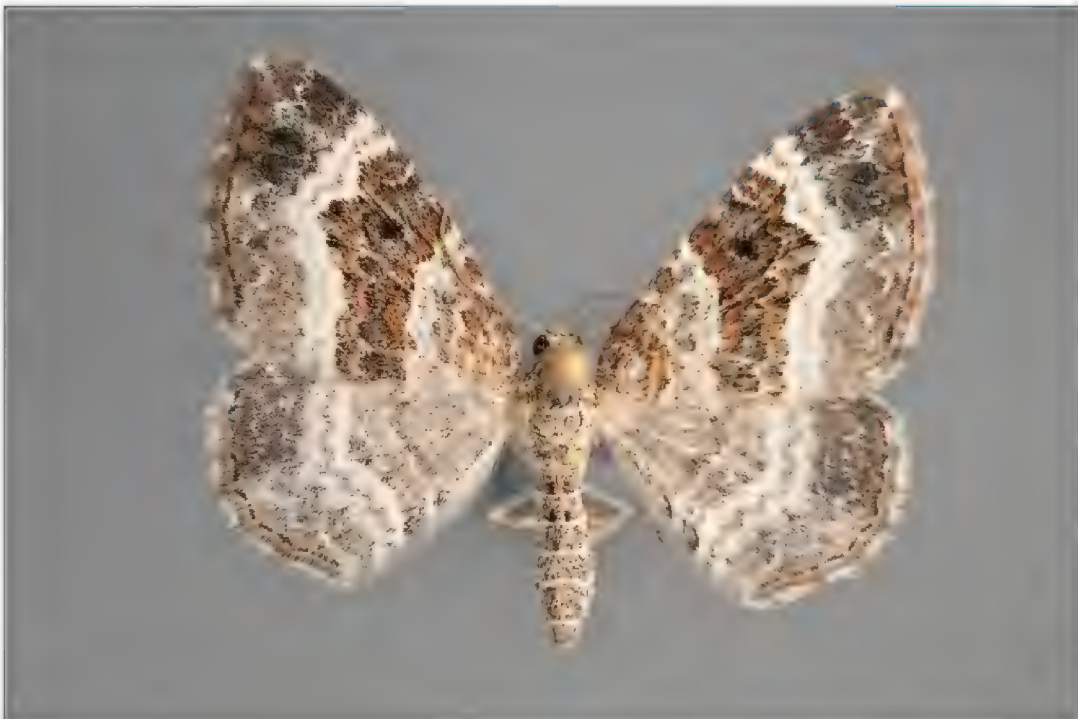


Figure 77.

Epirrhoe alternata, above



Figure 78.

Epirrhoe alternata, underneath

***Epirrhoe hastulata* (Hübner, 1790)**

- <http://eol.org/pages/285918/overview>
- http://www.lepiforum.de/lepiwiki.pl?Epirrhoe_Hastulata

Notes: Figs 79, 80



Figure 79.

Epirrhoe hastulata, above



Figure 80.

Epirrhoe hastulata, underneath

***Epirrhoe tristata* (Linnaeus, 1758)**

- <http://eol.org/pages/285474/overview>
- http://www.lepiforum.de/lepiwiki.pl?Epirrhoe_Tristata

Notes: Figs 81, 82



Figure 81.

Epirrhoe tristata, above



Figure 82.

Epirrhoe tristata, underneath

***Xanthorhoe ferrugata* (Clerck, 1759)**

- <http://eol.org/pages/288630/overview>
- http://www.lepiforum.de/lepiwiki.pl?Xanthorhoe_ferrugata

Notes: Figs 83, 84



Figure 83.

Xanthorhoe ferrugata, above



Figure 84.

Xanthorhoe ferrugata, underneath

Discussion

Results and discussion

Totally, 192 species of Larentiinae are recorded for Sweden (Elmqvist et al. 2011, http://www2.nrm.se/en/svenska_fjarilar/svenska_fjarilar.html). Bert Gustafsson listed 156 species occurring on Öland (<http://www2.nrm.se/en/catalogus.html.se>). Currently, 41 species are recorded for the territory of the Station Linné, which comprises 26.3% of the Öland species and more than 21% of the Swedish larentiine fauna. Interestingly, 37 species were sampled during 22 nights of light trapping in summer 2014 and 2015, when the weather was not quite favorable for collecting. For comparison, a recent rapid biotic survey at a 365 hectare Charitable Research Reserve in Ontario (Canada) revealed only nine larentiine species (Telfer et al. 2015). An unusual biodiversity registered for a small collecting site on Öland can be explained by use of effective sampling methods.

Most of the larentiine species were collected using a UV light trap. The exceptions are as follows: one specimen of *Eulithis testata* and one specimen of *Catarhoe cuculata* were attracted only to the Mercury vapor lamp. The efficiency of different types of traps in this study should be compared with caution. The Mercury vapor trap and the surrounding vegetation was checked once at night between 11 p.m. and 12 p.m. and emptied in the morning, after completion of light trapping, whereas the UV trap has been checked continuously and the geometrid moths flying near the trap and sitting on the leaves of trees and bushes were collected permanently. *Epirrhoe hastulata*, *E. tristata*, *Eupithecia exiguata* and *E. satyrata* were recorded only in Malaise trap samples collected during July 24 – August 12, 2008, May 12 – June 5, 2008, June 5-21, 2008, and June 1-15, 2007 respectively.

Morphological differences within *Gandaritis pyraliata* (Denis & Schiffermüller)

A series of specimens presumably belonging to the species *Gandaritis pyraliata* have been collected. The specimens display variation in the wing pattern above and underneath, in the male genitalia (the shape of the saccus) and in the female genitalia (the length of the ductus bursae and the shape of the signum). The specimens require more detailed study.

Malaise trap sampling of Lepidoptera

Malaise traps are effectively used for collecting small flying insects for many decades, after the trap has been described by Malaise (1937). Although butterflies and moths are sometimes target groups of large-scale malaise trap sampling for ecological and conservation studies (e.g. Basset et al. 2007, Campbell and Hanula 2007, Lamarre et al. 2012), collecting Lepidoptera by means of malaise traps is a challenging method. Designed for Diptera and Hymenoptera, a malaise trap indeed effectively samples Lepidoptera, as they get trapped within the malaise tent, flying upward towards either the sun (during the day) or the moon (at night) (see Lamarre et al. 2012). However, the specimens fall into a collecting jar filled with Ethanol, whereby the wing scales rub off easily. Generally, only specimens with distinct wing pattern can be reliably identified from the samples in Ethanol. The older the samples are, the more difficult it is to get a correct identification of Lepidoptera. For small moths it is necessary to study the genitalia or to perform a molecular analysis. Considering the results of present study, using only malaise traps for sampling Lepidoptera is advisable for well-studied faunas. Traditional methods, like net sweeping, light trapping or bait-traps deliver more suitable results.

Acknowledgements

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Supplementary material

Suppl. material 1: List of larentiine moth species (Lepidoptera: Geometridae) of the Station Linné

Authors: Schmidt, O.

Data type: occurrences

Filename: List_Taxon_Template-LarOLAND_Sweden.xls - [Download file](#) (177.00 kb)